



Floristic Compositions and Its Affinities to Phytogeographical Regions in Wadi Khulab of Jazan, Saudi Arabia

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

Wadi Khulab considers one of the most important wadis in Jazan, south-western Saudi Arabia. Thus the current work provides an analysis of the floristic composition, life form and chorology of plant life of the wadi, a total of 119 species related to 93 genera represented 44 vascular plants families were documented. Six families (Aizoaceae, Euphorbiaceae, Papilionaceae, Poaceae, Amaranthaceae and Asclepiadaceae) provided nearly half of the total number of species reported. Therophytes and chamaephytes are the most frequent life forms which may indicating a typical desert spectrum vegetation. The floristic composition of the different geomorphologic landscape units offered differences in species richness in the different sectors of the wadi, and the phytochoria. Monoregional and biregional areas contained 45 species (41%), while biregional species were 39 species (36%) respectively, while only two species (2%) were recorded in the pleuriregion. It is thus concluded that the region should be considered a hot-spot in the Kingdom in terms of floral diversity.

Keywords: Floristic composition; life forms; chorology; Wadi Khulab.

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1. INTRODUCTION

Saudi Arabia is a part of the Arabian Peninsula, about 2,250,000 km² comprises several distinct physiographical regions, such as mountains, wadis, sandy and rocky deserts, salt pans (Sabkhahs) and lava areas (Harrats), etc. [1]. Major wadis and their tributaries generally dry for the whole year or for successive years and formed through the dune formation [2]. The vegetation of wadis is not constant it varies from year to year, depending upon the moisture level [3]. Jazan province is situated in the south-western part of Saudi Arabia, their foothills are characterized by rocky slopes, cliffs and crevices with granite, sandy soil whereas the hilly areas are generally formed of rocky cliffs, rocky ridges, granite boulders, granite outcrops, granite sand stones and crevices [4]. [5] divided the Jazan region geomorphologically into three main landscapes Mountains (E1-Sarwat Mountains), Plains (Tihamah coastal plains) and islands including those between Jazan city and Farsan Islands. In several wadis of Saudi Arabia such as Wadi Al-Noman (Mecca), Wadi Arar (Northern border region) and Wadi El-Ghayl (Asir) life form composition of a typical desert flora with the majority of species are therophytes and chamaephytes. Distribution of the life form is closely related to topography and landform [6]. Species belonging to Saudi Arabia are distributed into three general categories, namely: the species of the Saharo-Sindian zone, Sudano-

Deccanian zone (in a broad sense) and the species of the Tropical African- Indian category [7,8]. Several studies on the floristic diversity and vegetation analysis in Tihamah plains of Saudi Arabia were performed [9,10,2,11,4]. There is no earlier reports on the vegetation which reflecting of the exciting environmental conditions of the Wadi Khulab so this study needed to survey and identification of the wild plants growing in the wadi and to study the vegetation types in terms of floristic composition, life-form and chorotype.

1.1 Study Area

Wadi Khulab is located in the south-western part of Saudi Arabia, between the Al-Khobh in the east and the Ahad Al Masariyah in the west. It lies between 16°46'0"N latitude and 43°16'0"E longitude (Fig. 1). The study area, approximately 40-50 km² long lies 70 meters above sea level. It is considered to be favorable for plant growth due to stagnant water after rainfall. According to [12], the study area lies within the subtropical dry zone, and has very hot summers and mild winters. The average annual temperature is 31.3°C; January and February are the coldest months with the lowest average temperature (26°C), while the hottest months is August with the highest average temperature (40°C). The maximum precipitation (12.0 mm) falls during August, while the minimum of about 5.0 mm falls during January (Fig. 2, Table 1).

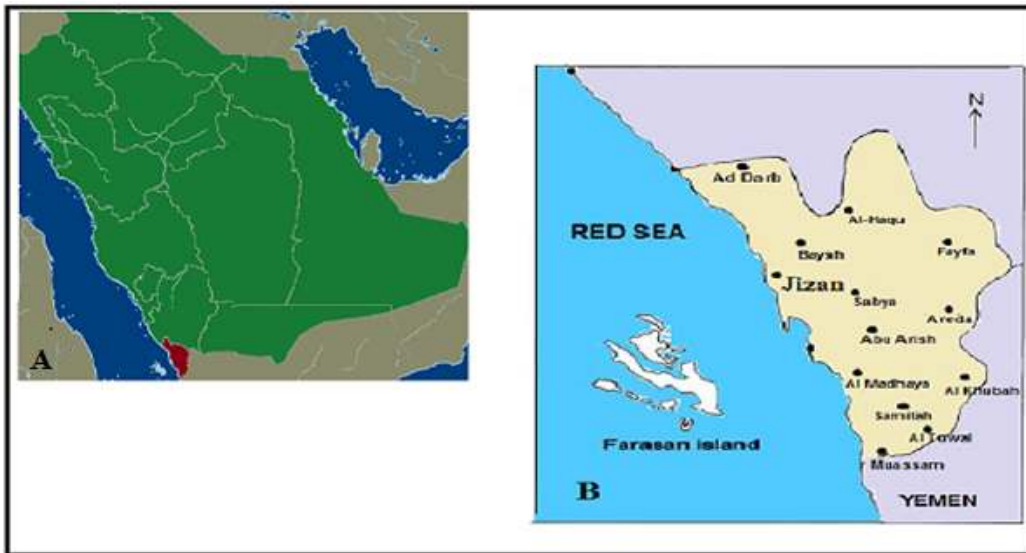


Fig. 1. A. Location map of Saudi Arabia showing the Southwestern border region. B. Location map of Jazan in which the study area

(Source: http://google-aps.pro/satellite/Samitah.Saudi_Arabia/)

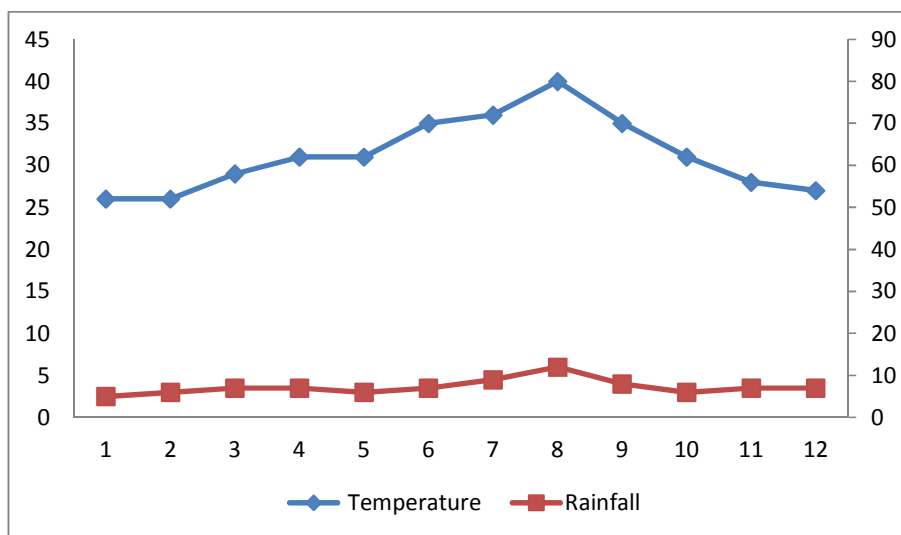


Fig. 2. Monthly average temperature and rainfall in the study area

Table 1. Mean average of temperature and rainfall in the study area

Months	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Temperature	26	26	29	31	31	35	36	40	35	31	28	27
Rainfall	5	6	6	7	6	7	9	12	8	6	6	6

2. MATERIALS AND METHODS

The study (Fig. 1) was conducted from April 2016 to February 2017. Species were recorded according to the classification of [13]. Life forms were determined following [14]. Phytogeographical analysis was carried out according to [15] and [16]. The collected plant specimens were identified and named according to [17,18,2] and [11] and deposited in Jazan University Herbarium, KSA (JAZUH).

3. RESULTS and DISCUSSION

3.1 Floristic Composition

A total of 119 taxa belonging to 93 genera and 44 families of phanerogams, were recorded in the 28 different surveyed sectors of Wadi Khulab. Their generic representations are quite variable. In terms of species richness, the Poaceae (Gramineae) was the most abundant family comprising 20% of the total taxa (Fig. 3 and Table 2), with 24 species related to 19 genera (Table 2). These floristic findings were in accordance with those of [19] and [20]. The abundance of the Poaceae might be due to water availability, including annual precipitation and soil properties and might therefore be indicative that the Poaceae is exceedingly well-

adapted to this environment. The families of Aizoaceae, Euphorbiaceae and Papilionaceae are represented by six taxa, although the variation in the number of their genera (Table 3). Amaranthaceae and Asclepiaceae are similar in representing five species of four genera. The dominance of members of Poaceae, Aizoaceae and Euphorbiaceae coincides with the findings reported by [4]. Cyperaceae, Malvaceae, Convolvulaceae, and Caesalpiniaceae families contained four species each representing 1, 3, 4 and 4 genera, respectively. Furthermore, three species exhibited in five families (Aracaceae, Cucurbitaceae, Solanaceae, Tiliaceae and Zygophyllaceae). Likewise, the restricted families of Acanthaceae, Nyctaginaceae, Lamiaceae, Aracaceae, Heliotropiaceae and Primulaceae having only two species related to two genera. The remainders (26 families) were represented by a single species (Fig. 3), these results were similar to studies of Marei, et al. 2014 on Tihama hill slopes of Jazan region.

3.2 Life Form

Table 4 shows the life form spectra of the recorded species, the highest life form recorded was for the therophytes constituted by 50 species representing 42% of the total species followed by the chaemophytes with 40 species

representing 34%. Likewise, 18 species of the phanerophytes estimated represented 15%. Furthermore, six species estimated as cryptophytes (*Asphodelus tenuifolius*, *Cyperus alopecuroides*, *Cyperus laevigatus*, *Cyperus alternifolius*, *Panicum turgidum* and *Tetrapogon tenellus*) compromised 5%. Also, four taxa of *Pulicaria undulate*, *Cucumis prophetarum*, *Cucumis melo* and *Pennisetum setaceum* seen as hemicryptophyte. Also, hydrophytes in this area represented by *Typha domengensis*. The five cultivated plants were represented by 5% (Fig. 4). Therophytes have the highest contribution followed by chameophytes indicating the adjustment of the flora to water balance. These results are in accordance with several studies in different regions of Saudi Arabia, such as: [21] in Taif, [22] in Hail region and [23] in Wadi Al-Jufair. The predominance of phanerophytes expresses that the flora is tertiary dominated with woody plants (shrub and trees). It

also displayed the level of woody flora management by the farmers using of woody species as green fertilizers and assisting natural regeneration. These results coincide with the findings of [22] and [20]. [24,25] and [26] also reported the domination of therophytes and chaemophytes as vegetation spectra in desert and semi-desert vegetation in other parts of the Middle East. Moreover, the dominance of therophytes, chaemophytes and phanerophytes over other life forms are seen to be a response to the hot dry climate, topographic variation and human and animal interference [27]; [28]. Three medicinal plants used by some local people, including *Acacia tortilis*, *Malva parviflora* and *Solanum glabratum*. Also, many poisonous plants such as *Anagallis arvensis*, *Calotropis procera*, *Datura innoxia*, *Datura stramonium*, *Leptadenia pyrotechnica*, *Solanum nigrum*, *Tribulus terrestris* and *Zygophyllum simplex* were recorded.

Table 2. Plant species recorded with their families, life forms and chorotypes

Family	Taxa	Life form*	Life span	Chorotype
Acanthaceae	<i>Anisotes triculus</i> (Forssk.) Nees	Ph	Per	SA +TR
	<i>Blepharis ciliaris</i> (L.) B. L. Burtt. Ch.	Ch	Ann	SA+ SZ
Amaranthaceae	<i>Amaranthus hybridus</i> L.	Th	Ann	PAL
	<i>Amaranthus graecizans</i> L.	Th	Ann	PAL
	<i>Aerva javanica</i> (Burm.F.) Juss	Ch	Per	SA + SZ
	<i>Achyranthes aspera</i> L.	Ch	Ann	Me + IT
	<i>Digera muricata</i> (L.) Mast.	Th	Ann	TR
Anacardiaceae	<i>Mangifera indica</i>	Ph	Per	Cult
Lamiaceae	<i>Ocimum basilicum</i> L.	Ch	Per	SZ
	<i>Ocimum forsskali</i> Benth	Ch	Per	SZ
Aracaceae	<i>Hyphaene thebaica</i> (L.) Mart	Ph	Per	SA+SZ
	<i>Phoenix dactylifera</i> L.	Ph	Per	SA+SZ
Astraceae	<i>Launaea mucronata</i> (Forssk.) Muschl.	Th	Ann	SA
	<i>Pluchea dioscoridis</i> (L.) DC.	Ch	Per	SA+SZ
	<i>Pulicaria undulata</i> (L.) C.A. May	He	Per	SA+SZ
Asphodelaceae	<i>Asphodelus tenuifolius</i> Cav	Cr	Ann	SA+SZ
Asclepiaceae	<i>Calotropis procera</i> (Ait.) R. Br.	Ph	Per	SA + SZ
	<i>Ceropegia variegata</i> Decne	Ch	Per	SA + SZ
	<i>Pentatropis nivalis</i> (Gmel.) Field & Wood	Ch	Per	SA +SZ
	<i>Leptadenia pyrotechnica</i> (Forssk.) Decne	Ph	Per	SA + SZ
	<i>Leptadenia arborea</i> (Forssk.) Schweinf	Ch	Per	SA + SZ
Aizoaceae	<i>Glinus lotoides</i> L.	Th	Ann	PAL
	<i>Mollugo nudicaulis</i> Lam.	Th	Ann	TR
	<i>Trianthema sheilae</i> A.G. Miller	Th	Ann	SA
	<i>Trianthema portulacastrum</i> L.	Th	Ann	SA
	<i>Sesuvium sesuviooides</i> (Fenzl) Verdc	Ch	Ann	TR
	<i>Zaleya pentandra</i> (L.) Jeffrey	Th	Ann	SZ
Chenopodiaceae	<i>Suaeda monoica</i> Forssk. ex J. Gmel	Ch	Per	SA + SZ
Cappariaceae	<i>Dipterygium glaucum</i> Decne	Ch	Per	SZ
Cactaceae	<i>Opuntia dillenii</i> (Ker-Gawl.) Haw.	Ch	Per	PAN
Celastraceae	<i>Catha edulis</i> (Vahl) Forssk	Ch	Ann	Cult
Cleomaceae	<i>Cleome gynandra</i> L.	Ch	Ann	SA + SZ

Family	Taxa	Life form*	Life span	Chorotype
Cyperaceae	<i>Cyperus conglomeratus</i> Rottb.	Th	Per	SA
	<i>Cyperus alopecuroides</i> Rottb. Descr	Cr	Per	PAN
	<i>Cyperus laevigatus</i> L.	Cr	Per	PAN
	<i>Cyperus alternifolius</i> L.	Cr	Per	SA
Convolvulaceae	<i>Convolvulus prostratus</i> Forssk.	Th	Per	SA +SZ
	<i>Ipomoea sinensis</i> (Desr.) Choisy in Mem	Th	Ann	SA+ SZ
	<i>Ipomoea hochstetteri</i> House	Th	Ann	SA+ SZ
	<i>Seddera virgata</i> Hochst. & Steud. ex Hochst.	Ch	Per	SZ
Caesalpinaceae	<i>Chamaecrista nigricans</i> (Vahl) Greene	Ph	Ann	SA + SZ
	<i>Prosopis juliflora</i> (Sw.) DC.	Ph	Per	SA
	<i>Senna italica</i> Mill	Ch	Per	SA + SZ
	<i>Senna alexandrina</i> Mill.	Ch	Ch	Per
Cucurbitaceae	<i>Cucumis prophetarum</i> L.	He	Ann	SA + SZ
	<i>Cucumis melo</i> L.	He	Ann	SA + SZ
Euphorbiaceae	<i>Zehneria anomala</i> C. Jeffrey	Ch	Per	SA + SZ
	<i>Acalypha fruticosa</i> Forssk.	Th	Ann	SA
	<i>Acalypha indica</i> L.	Th	Ann	SA
	<i>Croton bonplandianus</i> L.	Th	Ann	PAL
	<i>Euphorbia granulata</i> Forssk.	Th	Ann	SA+ SZ
	<i>Euphorbia hirta</i> , L.	Th	Ann	COSM
Heliotropiaceae	<i>Ricinus communis</i> L.	Ph	Per	TR
	<i>Heliotropium pterocarpum</i> (DC.) Steud. & Hochst.	Ch	Ann	SA + SZ
	<i>Heliotropium longiflorum</i> Steud. & Hochst.	Ch	Ann	TR+SA
Malvaceae	<i>Abutilon pannosum</i> (G. Forst.) Schlecht.	Ch	Per	SA
	<i>Abutilon hirtum</i> (Lamk.) Sw	Ch	Per	PAN
	<i>Malva parviflora</i> L.	Th	Ann	ME+IT
	<i>Senra incana</i> Cav.	Ch	Per	SA + SZ
Mimosaceae	<i>Acacia ehrenbergiana</i> Hayne	Ph	Per	SA + SZ
	<i>Acacia tortilis</i> (Forssk.) Hayne	Ph	Per	SA + SZ
Menispermaceae	<i>Cocculus pendulus</i> (J.R. & G. Forst.) Diels	Ph	Per	SA + SZ
Moraceae	<i>Ficus populifolia</i> Vahl	Ph	Per	SA
Nyctaginaceae	<i>Boerhavia diffusa</i> L.	Ch	Ann	SA+TR
	<i>Boerhavia repens</i> L.	Ch	Ann	SA+SZ
Papilionaceae	<i>Alysicarpus rugosus</i> (Willd.) DC.	Ch	Ann	SA
	<i>Indigofera oblongifolia</i> L.	Th	Per	SZ
	<i>Indigofera spinosa</i> Forssk.	Ch	Per	SA+SZ
	<i>Indigofera argentea</i> Burm	Ch	Ann	SA
	<i>Tephrosia purpurea</i> (L.) Pers.	Ch	Per	SA
	<i>Tephrosia nubica</i> (Boiss.) Bak	Ch	Ann	SA
Polygonaceae	<i>Polygala erioptera</i> DC.	Ch	Ann	TR
Poaceae	<i>Aristida mutabilis</i> Trin. & Rupr.	Th	Ann	SA
	<i>Cenchrus pennisetiformis</i> Hochst. & Steud.	Th	Per	SZ
	<i>Cenchrus ciliaris</i> L.	Th	Per	SA+SZ
	<i>Chloris barbata</i> Sw.	Th	Per	SZ
	<i>Dactyloctenium aegyptium</i> (L.) Willd	Th	Ann	PAL
	<i>Dactyloctenium scindicum</i> Boiss.	Th	Ann	SZ
	<i>Digitaria ciliaris</i> (Retz.) Koel	Th	Ann	SA + SZ
	<i>Digitaria velutina</i> (Forssk.) Beauv.	Th	Ann	SA + SZ
	<i>Desmostachya bipinnata</i> (L.) Stapf	Th	Per	SA + SZ
	<i>Dinebra retroflexa</i> (Vahl) Panz	Th	Ann	SZ
	<i>Eragrostis ciliaris</i> (L.) R. Br.	Th	Per	SZ
	<i>Eragrostis minor</i> Host	Th	Per	SZ
	<i>Eriochloa fatmensis</i> (Hochst & Steud.) Clayton	He	Per	SA

Family	Taxa	Life form*	Life span	Chorotype
	<i>Echinochloa colona</i> (L.) Link	Th	Ann	PAN
	<i>Ochthochloa compressa</i> (Forssk.) Hilu	Th	Per	SZ
	<i>Paspalidium desertorum</i> (A.Rich.) Stapf.	Th	Per	SZ
	<i>Panicum turgidum</i> Forssk.	Cr	Per	SA + SZ
	<i>Sporobolus helvolus</i> (Trin.) Dur. & Schinz	Th	Per	SZ+ TR
	<i>Saccharum spontaneum</i> L.	Th	Per	SZ
	<i>Schoenefeldia gracilis</i> Kunth	Th	Per	SZ
	<i>Setaria viridism</i> (L.) P. Beauv	Th	Ann	ME+IT+SA
	<i>Sorghum bicolor</i> (L.) Moench	Th	Per	Cult
	<i>Tetrapogon tenellus</i> (Roxb.) Chiov	Cr	Per	ME+IT+SA
	<i>Zea mays</i> L.	Th	Ann	Cult
Portulacaceae	<i>Portulaca oleracea</i> L.	Th	Ann	COSM
Salvadoraceae	<i>Salvadora persica</i> L.	Ph	Per	SA + SZ
Scrophulariaceae	<i>Scoparia dulcis</i> L.	Ch	Per	SA
Primulaceae	<i>Anagallis arvensis</i> L.	Th	Ann	COSM
	<i>Schweinfurthia pterosperma</i> (Rich.) A. Br.	Th	Ann	SA
Solanaceae	<i>Datura innoxia</i> L.	Th	Ann	PAN
	<i>Datura stramonium</i> L.	Ch	Ann	SA
	<i>Solanum glabratum</i> Dunal Hist.	Ch	Ann	SA
Sterculiaceae	<i>Waltheria indica</i> L.	Ch	Per	PAN
Sapotaceae	<i>Sideroxylon buxifolium</i> Hutch	Ph	Per	TR+SA
Meliaceae	<i>Azadirachta indica</i> A. Juss	Ph	Per	TR
Pedaliaceae	<i>Sesamum indicum</i> L.	Ch	Ann	Cult
Rubiaceae	<i>Kohautia caespitosa</i> Schnizl	Ch	Ann	TR+SA
Tamaricaceae	<i>Tamarix nilotica</i> (Ehrenb.) Bunge.	Ph	Per	SA+SZ
Tiliaceae	<i>Corchorus depressus</i> (L.) Stocks	Th	Ann	SA+ TR
	<i>Corchorus antichorus</i> (L.) Raeusch.	Th	Ann	SZ
	<i>Grewia tenax</i> (Forssk.) Fiori	Ph	Per	TR
Urticaceae	<i>Urtica urens</i> L.	Th	Ann	TR+SZ
Typhaceae	<i>Typha domingensis</i> (Pers.) Poir	Hy	Per	PAN
Verbenaceae	<i>Phyla nodiflora</i> (L.) Greene	Ch	Per	PAL
Zygophyllaceae	<i>Fagonia schweinfurthii</i> (Hadidi) Hadidi	Ch	Per	He
	<i>Tribulus terrestris</i> L.	Th	Ann	COSM
	<i>Zygophyllum simplex</i> L.	Th	Ann	SA+SZ

*Ph= Phanerophytes; Ch= Chamaephytes; Cr= Cryptopyte, He= Hemicryptophyte and Th= Therophytes. The Chorotypes types are: COSM= Cosmopolitan, IT= Irano-Turanian, ME= Mediterranean, SA= Saharo-Arabian, SZ=Sudano-Zambeian, TR= Tropical, PAN= Panatropical, and PA= Palaeotropical,

3.3 Chorology

From the phytogeographical point of view, the recorded species in the different sectors of the studied valley may be classified as monoregional, biregional or pluriregional (Table 5).

Monoregional area has in total 45 species representing 41%, in which 20, 18 and 7 species are within the Saharo-Arabian, Sudano-Zambeian and tropical regions, respectively. The highest percentage in this area was recorded in Saharo-Arabian (18%). Biregional area included 39 species with 36% in which 29 species were shared by Saharo-Arabian and Sudano-Zambeian regions (27%), six species were shared by Saharo-Arabian and tropical

regions, and two species of *Achyranthes aspera* and *Malva parviflora* were recorded in the Mediterranean and Irano-Turanian regions and the two species of *Anisotes triculus* and *Boerhavia diffusa* were estimated in the Sudano-Zambeian and tropical regions. Pleuriregional (Mediterranean, Irano-Turanian and Saharo-Arabian) area has only 2 species (*Tetrapogon villosus* and *Setaria viridis*) representing 2%. Also, eight species (8%) were reported within the panatropical area and six species (6%) were recorded in paleotropical area. Cosmopolitan plants comprised 4% of the population are four species, *Euphorbia hirta*, *Portulaca oleracea*, *Anagallis arvensis* and *Tribulus terrestris* (Fig. 5). These results agree with chorological characteristic in other parts of Saudi Arabia [29] on Khulais region, [30] on Wadi Al-Noman and

[31] on Wadi Arar. The results indicate that between Saharo and Sindian. Genera of Saharo-Saharo-Arabian elements predominate the Arabian are covered most of the deserted studied area (66 species, 55.5%) because this area of Sindian from the red sea coast to the area mainly deserted and located within the belt Gulf coast through the Empty Quarter of Saharo-Sindian also it is a part of that belt desert.

Table 3. Systematic composition of the studied flora families in the study area

Family	Genera	%	Species	%	Habit		
					Tree	Shrub	Herb
Acanthaceae	2	2	2	2		+	+
Amaranthaceae	4	4	5	4			+
Anacardiaceae	1	1	1	1	+		
Aracaceae	2	2	2	2	+		
Astraceae	3	3	3	2		+	+
Asphodelaceae	1	1	1	1			+
Asclepiaceae	4	4	5	4		+	
Aizoaceae	5	5	6	5			+
Chenopodiaceae	1	1	1	1			+
Capparidaceae	1	1	1	1			+
Cactaceae	1	1	1	1	+		
Clasteraceae	1	1	1	1		Sub-shrub	
Cleomaceae	1	1	1	1			+
Cyperaceae	1	1	4	3			+
Convolvulaceae	4	4	4	3		+	+
Caesalpinaceae	4	4	4	3		Sub-shrub	+
Cucurbitaceae	3	3	3	3			+
Euphorbiaceae	4	4	6	5	+	+	+
Heliotropiaceae	2	2	2	2			
Lamiaceae	1	1	2	2			+
Malvaceae	3	3	4	4			+
Mimosaceae	1	1	2	2	+		
Menispermaceae	1	1	1	1		+	
Moraceae	1	1	1	1	+		
Nyctaginaceae,	1	1	2	2			+
Papilionaceae	3	3	6	5			+
Polygonaceae	1	1	1	1			+
Poaceae	20	21	24	20			+
Portulacaceae	1	1	1	1			+
Salvadoraceae	1	1	1	1	+		
Scrophulariaceae	1	1	1	1			+
Primulaceae	2	2	2	2			+
Solanaceae	2	2	3	2			+
Sterculiaceae	1	1	1	1		Sub-shrub	
Sapotaceae	1	1	1	1		+	
Meliaceae	1	1	1	1	+		
Pedialaceae	1	1	1	1			+
Rubiaceae	1	1	1	1		Sub-shrub	
Tamaricaceae	1	1	1	1	+		
Tiliaceae	2	2	3	2			+
Urticaceae	1	1	1	1			+
Typhaceae	1	1	1	1			+
Verbenaceae	1	1	1	1			+
Zygophyllaceae	3	3	3	3			+

Table 4. Aggregation summary showing the distribution of collected plant species into their growth types and life forms

Total number			Growth type			Life form		
Families	Genera	Species	Type	Species no.	%	Life form*	Species No.	%
44	93	119	Annual	55	46	Ph	18	15
--	--	--	Perennial	64	54	Ch	40	34
--	--	--	--	--	--	Cr	6	5
--	--	--	--	--	--	Th	50	42
--	--	--	--	--	--	Hy	1	1
--	--	--	--	--	--	He	4	3
--	--	--	Total	119	100	Total	119	100

*Ph= phanerophyte, Ch= chamaephyte, Cr= cryptopyte, Th= therophyte, Hy= hydrophyte and He= hemicryptopyte

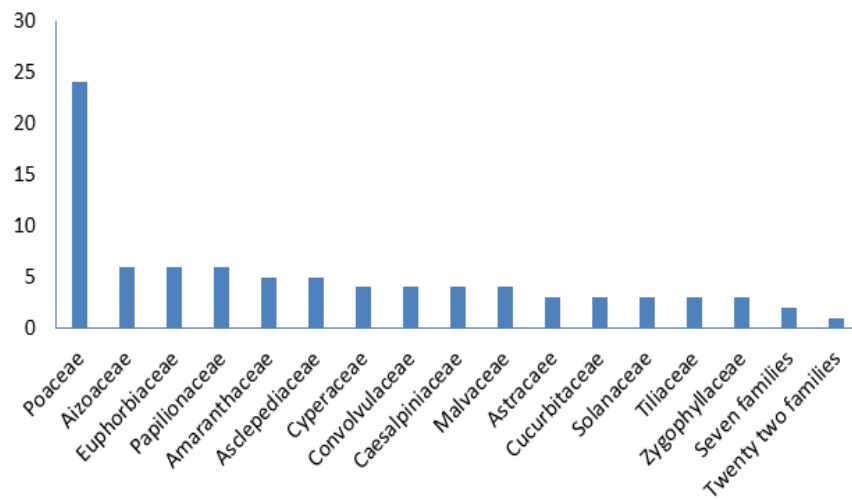


Fig. 3. Floristic composition of the different families in Wadi Khulab

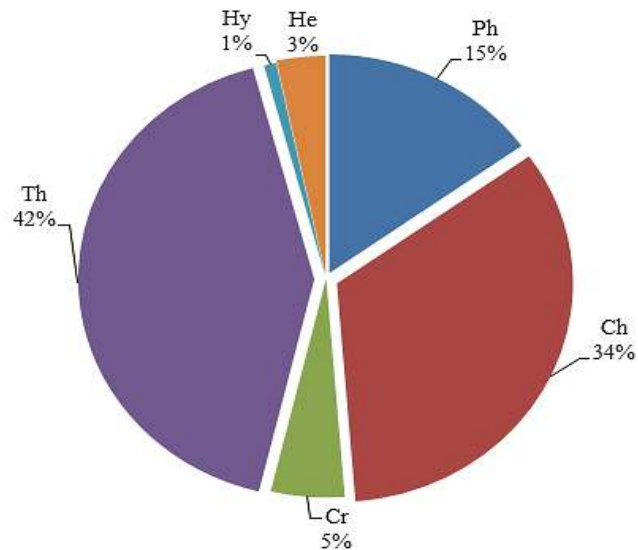


Fig. 4. Life-form relative spectrum of Wadi Khulab vegetation

Ph=phanerophyte, Ch= chamaephyte, Th = therophyte Cr = cryptopyte and Hy= hydrophyte

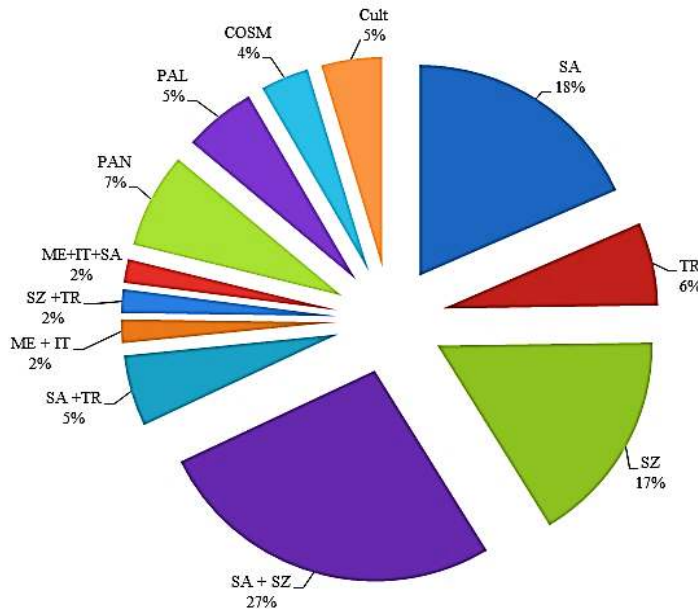


Fig. 5. Floristic category spectrum of Khulab

TR = Tropical, SA = Saharo-Arabian, SZ = Sudano-Zambeziyan, ME = Mediterranean, IT = Irano-Turanian, PAN = Pantropical, PAL = Paleotropical, COSM = Cosmopolitan and Cult = Cultivated

Table 5. Phytochoric distribution of studied plant species

Phytochoria type	Species number	Percentage (%)
Monoregional		
SA	20	18.00
TR	7	6.00
SZ	18	17.00
Total	45	41.00
Biregional		
SA + SZ	29	27.00
SA + TR	6	5.00
ME + IT	2	2.00
SZ + TR	2	2.00
Total	39	36.00
Pleuregional		
ME+IT+SA	2	2.00
Total	2	2.00
PAN	8	7.00
PAL	6	5.00
COSM	4	4.00
Cult	5	5.00
Total	23	21.00

4. CONCLUSION

Wadi Khulab located in the south-western of Saudi Arabia which floristically diverse in the

biodiversity. The present survey recorded 119 taxa and represented over one quarter of the checklist recorded before in Jazan area by [11] who identified and described about 524 species which belong to these floristic structures. The total number of identified genera was 93 indicating a high generic index of 78% (93/119). This high diversity in the wadi was due to the abundance of rainfall sources and soil fertility which considered as a biotic factor. The floristic composition of the wadi is rich in species, genera and botanical families due to rainfall water balance. Poaceae is the best represented botanical family followed by five families (Aizoaceae, Euphorbiaceae, Papilionaceae, Amaranthaceae and Asclepiaceae) constituted the main bulk of the wild plants in the study area. Besides that, the life forms are diverse but the therophyte and chameophytes are the dominant. The growth types in this study were perennial types were 64 species while the annual types were 55 species. Their predominance makes the phytoclimate of the wadi thermo-chameophytic type. In addition, the areas of Saharo-Arabian and Saharo-Arabian and Sudano-Zambeziyan are the most dominant chorotypes represented more than third of total species. There are some plant species were left unrecorded hence need long-term comprehensive study to document.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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